REMARKS

Present Status of the Application

The Office Action rejected all presently-pending claims 1-18. Specifically, the Office Action rejected claims 1-9 under 35 U.S.C. 103(a) as being unpatentable over Ji (US 6,787,409) and admitted prior art. The Office Action also rejected claims 10-18 under 35 U.S.C. 103(a) as being unpatentable over Ji and admitted prior art and further in view of Huang (U.S. 6,653,203).

No claim is amended, and claims 1-18 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Office Action Rejections

The Office Action rejected claims 1-9 under 35 U.S.C. 103(a), as being unpatentable over Ji (US 6,787,409) and admitted prior art. Applicant respectfully traverses the rejections for at least the reasons set forth below.

> To establish a prima facie case of obviousness under 35 U.S.C. 103(a), each of three requirements must be met. First, the reference or references, taken alone or combined, must teach or suggest each and every element in the claims. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skilled in the art, to combine the references in a manner resulting in the claimed invention. Third, a reasonable expectation of success must exist. Moreover, each of the three requirements must " be found in the prior art, and not be based on applicant's disclosure." See M.P.E.P. 2143, 8th ed., February 2003.
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> When obviousness is based on the teachings of multiple prior art references, the movant must also establish some "suggestion, teaching, or motivation" that would have led a person of ordinary skill in the art to combine the relevant prior

art teachings in the manner claimed. See Tec Air, Inc. v. Denso Mfg. Mich. Inc., 192 F.3d 1353, 1359-60 (Fed. Cir. 1999); Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1572 (Fed. Cir. 1996).

The present invention is in general related a manufacturing method of a shallow trench isolation structure as claim 1 recites:

Claim 1. A manufacturing method of a shallow trench isolation (STI) structure, the method comprising:

providing a substrate, wherein a patterned pad oxide layer and a mask layer are formed on the substrate, and at least a trench is formed in the substrate, wherein the trench is formed by exposing a portion of the pad oxide layer and the mask layer;

forming a liner layer on a surface of the trench;

performing a high density plasma chemical vapor deposition (HDP-CVD) process to form an isolation layer on the substrate and over the trench, wherein the trench is completely filled with the isolation layer, wherein the high density plasma chemical vapor deposition (HDP-CVD) process comprises a first stage process and a second stage process, and a bias power of the second stage process is higher than a bias power of the first stage process, and ***a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process***;

removing the isolation layer over the trench;

removing the mask layer; and

removing the pad oxide layer.

The office action points out even though Ji is silent about the deposition to etching ratio of the second step is lower than the deposition to etching ratio of the first stage; however, he describes the same process of using a higher bias in the second step, which would provide a lower deposition to etching ratio in the second step. However, Applicants do not agree. This is because using a higher bias may not directly provide a lower deposition to etching ratio in a HDP-CVD process. Furthermore, in claim 1 of the present application, both the two conditions of a bias power of the second stage process is higher than a bias power of the first stage process and a deposition to etching ratio of the second stage process is lower than a deposition to etching

ratio of the first stage process are provided, and thus the bombardment effect of the second stage process is larger than that of the first stage process, and ***the isolation material deposited by the second stage process is denser*** (also described in paragraph [0027] of the specification). As a result, the layers deposited by the first and second stage processes have different etch rates.

However, the oxide liner and the bulk oxide layer formed with two-step HDP-CVD in Ji's reference ***have similar etch rates*** (see abstract and col. 4, line 59-col. 5, line 63). In other words, the oxide liner and the bulk oxide layer formed with two-step HDP-CVD of Ji have similar density such that the etch rates of the two layers are similar. Therefore, Ji fails to disclose, teach or suggest the feature of a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process. The references combined do not teach or suggest each and every element in claim 1 and thus a prima facie case of obviousness has not been established by the office action.

In addition, Ji does not need to perform the step of removing the mask layer and the pad oxide layer. This is because the stack layer 14 discloses by Ji comprising silicon nitride and polysilicon together, or silicon nitride alone is used to eventually form gates of flash memory transistors (col. 3, lines 50-53). Hence, the stack layer 14 is not removed. When an etching step, shown in Figs 7-8, is performed, the bulk oxide layer 20 and the liner layer 19 are etched downward below a top surface 32 of stack structures 14' to expose sidewall portions of stack structures 14' without grooving at the edges of the trench (col. 6, lines 13-18). Therefore, the method of Ji is used to resolve the problem of grooving generation when etching back the bulk oxide layer 20 and the liner layer 19 formed in the trench. However, in the admitted prior art, a divot 112 around the corner of the trench 106 is generated when removing the mask layer 104

and the pad oxide layer 102. In other words, the divot 112 does not generate when etching the oxide layer 110. Therefore, there is not any suggestion or motivation, in the references generally available to one of ordinary skilled in the art, to combine the references in a manner resulting in the claimed invention.

For at least the foregoing reasons, Applicants respectfully submit that independent claim 1 patently define over the prior art references, and should be allowed. For at least the same reasons, dependent claims 2-9 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

The Office Action rejected claims 10-18 under 35 U.S.C. 103(a), as being unpatentable over Ji and admitted prior art and further in view of Huang (U.S. 6,653,203). Applicant respectfully traverses the rejections for at least the reasons set forth below.

The present invention also provides a manufacturing method of a shallow trench isolation structure as claim 10 recites:

10. A manufacturing method of shallow trench isolation (STI) structure, the method comprising:

providing a substrate, wherein a patterned pad oxide layer and a mask layer are formed on the substrate, and at least a trench is formed in the substrate, wherein the trench is formed by exposing a portion of the pad oxide layer and the mask layer;

performing an etch-back process to the mask layer to pull back the mask layer;

forming a liner layer on a surface of the trench;

performing a high density plasma chemical vapor deposition (HDP-CVD) process to form an isolation layer on the substrate and over the trench, wherein the trench is completely filled with the isolation layer, wherein the high density plasma chemical vapor deposition (HDP-CVD) process comprise a first stage process and a second stage process, a bias power of the second stage process is higher than a bias power of the first stage process, ***and a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process***;

removing the isolation layer over the trench;

removing the mask layer; and

removing the pad oxide layer.

As discussed as above, Ji fails to disclose, teach or suggest the feature of a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process. Huang and the admitted prior art also fail to teach or suggest the feature of a deposition to etching ratio of the second stage process is lower than a deposition to etching ratio of the first stage process. The references combined do not teach or suggest each and every element in claim 10 and thus a prima facie case of obviousness has not been established by the office action.

In addition, the method provide by Huang is used to avoid voids generating within a filling material when depositing the filling material into a high aspect ratio trench. Huang does not describe about the grooving or divot issue when removing the pad oxide and mask layer or when removing the filling material layer. Therefore, there is not any suggestion or motivation, in the references generally available to one of ordinary skilled in the art, to combine the references in a manner resulting in the claimed invention.

For at least the foregoing reasons, Applicants respectfully submit that independent claim 10 patently define over the prior art references, and should be allowed. For at least the same reasons, dependent claims 11-18 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

Application No.: 10/761,993 **Docket No.: JCLA12335**

CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,
J.C. PATENTS

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Jiawei Huang
Registration No. 43,330

4 Venture, Suite 250
Irvine, CA 92618
Tel.: (949) 660-0761
Fax: (949)-660-0809